

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reissue Application of:

KENNETH O. McELRATH ET AL.

Serial No.: 10/719,693

Filed: November 21, 2003

For: CARBON NANOTUBE PARTICULATE
ELECTRON EMITTERS

Confirmation No.: 1355

Group Art Unit: 2879

Examiner: Natalie K. Walford

Attorney Docket: 3006.002000/KDG

CUSTOMER NO. 23720

APPEAL BRIEF

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicants submit this Appeal Brief pursuant to 37 C.F.R. § 41.37. If the fee payment submitted with this brief is missing or insufficient, please deduct the fee from Williams, Morgan & Amerson, P.C. Deposit Account No. 50-0786/3006.002000KG.

I. REAL PARTY IN INTEREST

The real party in interest is Carbon Nanotechnologies, Inc.

II. RELATED APPEALS AND INTERFERENCES

There are no prior or pending appeals, interferences, or judicial proceedings known to appellant, appellant's legal representative, or the assignee which are related to, directly affect, or are directly affected by, or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF THE CLAIMS

Claims 1-10 are rejected and are the subject of this appeal. Claims 11-23 are canceled.

IV. STATUS OF AMENDMENTS

No amendments have been filed in this application after the final rejection.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The claims relate to electron emitters that comprise a carbon nanotube particulate on a surface. A brief explanation of carbon nanotubes is given in the application at page 2, line 14 through page 3, line 13. The carbon nanotube particulate in the claimed invention comprises entangled small-diameter carbon nanotubes arranged in a three-dimensional network. The small-diameter nanotubes have an outer diameter in a range of about 0.5 nm and about 3 nm, and the carbon nanotube particulate has a cross-sectional dimension in a range of about 0.1 micron and about 100 microns. (See page 7, lines 9-30, and page 4, line 23, through page 5, line 1.)

Examples of such carbon nanotube particulates are shown in Figures 1A and 1B. Certain uses of such electron emitters are described at page 31, line 26 through page 32, line 28.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

- A. Are claims 1-10 unpatentable under 35 U.S.C. § 103(a) in view of Smalley et al., US Pub. 2002/0085968 (“*Smalley*”) and Jin et al., U.S. Patent 6,250,984 (“*Jin*”)?
- B. Are claims 1-2 and 5-6 unclear and indefinite due to the use of the term “cross-sectional dimension”?

VII. ARGUMENT

A. THE CLAIMS ARE NONOBVIOUS OVER THE PRIOR ART

The Examiner rejected Claims 1-10 under 35 U.S.C. § 103(a) as obvious over Smalley et al., US Pub. 2002/0085968 (“*Smalley*”) in view of Jin et al., U.S. Patent 6,250,984 (“*Jin*”). Claim 1 requires, *inter alia*, an electron emitter that comprises a “carbon nanotube particulate on a surface wherein the carbon nanotube particulate comprises entangled small-diameter carbon nanotubes arranged in a three-dimensional network . . . wherein the carbon nanotube particulate has a cross-sectional dimension in a range of about 0.1 micron and about 100 microns.”

Jin discloses a process for fabricating nanotube field emitter structures. As shown in Figures 2A-2F and described at column 5, line 40 through column 9, line 11, the process begins by mixing carbon nanotubes 10 (e.g., a “tangled spaghetti” configuration) and conductive powder 12 (e.g., metal or alloy powder). (Figure 2A, and column 5, lines 43-64.) Next, the composite of nanotubes and conductive powder is pressed into a green compact 14 and either sintered or melted to form an ingot. (Figure 2B, and column 7, lines 35-55.) Next, the ingot is

sectioned parallel to the intended emitter surface. (Figure 2C, and column 8, lines 1-8.) The sectioning creates a number of broken nanotube ends at the sectioned surface.

After shaping the ingot (Figure 2D, and column 8, lines 16-19), a layer of metal is etched from the ingot 17 surface, to provide a “multitude of protruding nanotubes.” (Figure 2E, and column 8, lines 28-31.) Although the nanotube ends that protrude from the ingot are not necessarily parallel to each other, “the average deviation of the long axis of the nanotubes from a line normal to the supporting surface at the point on the surface from which the nanotube protrudes, is less than 45° . . .” (Column 8, lines 47-67.) The structure produced by this process can then be assembled into a field emitting device. (Figure 2F, and column 9, lines 3-11.)

Therefore, although the ingot prepared by *Jin* contains a spaghetti-like mass of nanotubes, they are buried under the surface of the ingot. All that protrudes from the surface of the ingot are individual nanotubes, as can be seen clearly in Figures 2E and 12. (See the nanotube emitters 112 in Figure 12, which are described at column 15, lines 38-42.) Thus, the nanotube structures that are *on* the surface in *Jin* (i.e., extending outward from the surface) are not particulates that each comprise a plurality of entangled nanotubes, but instead are individual nanotubes. The carbon nanotubes arranged in a three-dimensional network in *Jin* are beneath the surface of the ingot, not *on* the surface as required by claim 1. Furthermore, *Jin* makes no suggestion that there should be a particulate that comprises entangled carbon nanotubes on top of a surface. *Jin* actually teaches away from such a structure, since *Jin* emphasizes the importance of emission from individual broken nanotube tips, rather than from a tangled aggregate of nanotubes. (Column 4, lines 38-55.)

Smalley teaches a felt or a mat comprising a tangled collection of single-wall carbon nanotube ropes stuck together having sizes of 10 mm^2 , 100 mm^2 , 1000 mm^2 or greater. (See

Smalley, paragraph 89.) Mats and felts are two out of many different nanotube structures disclosed by *Smalley*, and there is no suggestion that these structures should or could be used as electron emitters. Furthermore, the dimensions that the Examiner references in paragraph 88 of *Smalley* relate to ropes of nanotubes, as opposed to the felt in paragraph 89 which comprises a collection of multiple ropes stuck together in a mat. (See *Smalley* at paragraph 89, lines 1-4.) Therefore, even if one could consider the felt of *Smalley* to be relevant to electron emitters, which *Smalley* plainly does not suggest, the dimensional range recited in claim 1 for the nanotube particulate would still not be satisfied by the felt of *Smalley*.

An obviousness rejection based on a combination of references requires a motivation or suggestion to combine the references, coupled with a reasonable expectation of success. The motivation or suggestion must be in the prior art, in the knowledge of one of ordinary skill in the relevant art, or in some cases in the nature of the problem to be solved. *In re Huston*, 308 F.3d 1267, 64 U.S.P.Q.2d 1801, 1810 (Fed. Cir. 2002); *Boehringer Ingelheim Vetmedica, Inc. v. Schering-Plough Corp.*, 320 F.3d 1339, 65 U.S.P.Q.2d 1961, 1971-1972 (Fed. Cir. 2003).

Furthermore, the references must suggest the desirability, and thus the obviousness of making the combination, without the benefit of hindsight reasoning. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not in applicant's disclosure. "One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

There is no motivation or suggestion to combine the nanotube emitter structure of *Jin*, in which a tangled mass of nanotubes are buried in a metal ingot and only individual nanotube tips protrude from the surface of the ingot, with the felt or mat of *Smalley*, which has nothing to do

with electron emitters. Furthermore, even if one did make this combination, there is still nothing to suggest that the tangled mass of carbon nanotubes should be on the surface of a substrate, rather than buried in that substrate.

Because a *prima facie* case of obviousness has not been established for claim 1, this claim cannot be held obvious under 35 U.S.C. § 103(a). Claims 2-10 depend directly or indirectly on claim 1 and are nonobvious for same reasons.

B. THE CLAIMS ARE DEFINITE AND MEET THE REQUIREMENTS OF 35 U.S.C. § 112

The Examiner has objected to Claims 1-2 and 5-6 and contends that the term “cross-sectional dimension” is unclear. Although the office action does not explicitly state that these claims are rejected as being indefinite under 35 U.S.C. § 112, second paragraph, in case the objection might be construed to include such a rejection implicitly, applicant will explain herein why these claims meet all applicable requirements.

Section 112, second paragraph, requires that the claims, when read in light of the specification, reasonably apprise a person skilled in the art of the scope of the invention. *Utah Medical Products, Inc. v. Graphic Controls Corp.*, 350 F.3d 1376, 69 U.S.P.Q.2d 1136, 1139 (Fed. Cir. 2003). If a person of ordinary skill in the art would understand the claim, then § 112, second paragraph, is satisfied. *In re Oetiker*, 23 U.S.P.Q.2d 1661, 1662 (Fed. Cir. 1991).

The Examiner has stated that the meaning of “cross-sectional dimension” is unclear in the subject claims. Claim 1, for example, states that “the carbon nanotube particulate has a cross-sectional dimension in a range of about 0.1 micron and about 100 microns.” Examples of the carbon nanotube particulates are shown in Figures 1A and 1B. From the examples shown in these figures, one can see that the particulates can have a range of cross-sectional dimensions.

Applicant has used the term “cross-sectional dimension” in accordance with the usual and customary meaning of the words as defined in *The American Heritage Dictionary, Second College Edition*, Houghton Mifflin Company, Boston, 1982. In this dictionary, the word “cross-section” is defined as “[a] section formed from a plane cutting through an object, usually at right angles to an axis.” The word “dimension” is defined as “[a] measure of spatial extent, esp. width, height, or length.” (Copies of these dictionary definitions are included in the Evidence Appendix.) Therefore, applicant believes that the term “cross-sectional dimension” is clear and would be understood by a person skilled in the art. That is all that is required by § 112, second paragraph.

VIII. CLAIMS APPENDIX

The claims that are the subject of the present appeal (1-10) are listed in the attached Claims Appendix.

IX. EVIDENCE APPENDIX

Attached in the Evidence Appendix are copies of dictionary definitions of “cross section” and “dimension.” These documents were introduced into the record as attachments to the response to office action that was filed on October 11, 2006.

X. RELATING PROCEEDINGS APPENDIX

There is no Related Proceedings Appendix for this appeal.

XI. CONCLUSION

Applicants respectfully request that the rejections of claims 1-10 be reversed.

Respectfully submitted,

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CLAIMS APPENDIX

1. An electron emitter comprising a carbon nanotube particulate on a surface wherein the carbon nanotube particulate comprises entangled small-diameter carbon nanotubes arranged in a three-dimensional network wherein the small-diameter nanotubes have an outer diameter in a range of about 0.5 nm and about 3 nm, wherein the carbon nanotube particulate has a cross-sectional dimension in a range of about 0.1 micron and about 100 microns.
2. The electron emitter of claim 1 wherein the particulate has a cross-section dimension in the range of about 0.1 micron and about 3 microns.
3. The electron emitter of claim 1 wherein the carbon nanotubes are selected from the group consisting of single-walled carbon nanotubes, double-walled carbon nanotubes, triple-walled carbon nanotubes, quadruple-walled carbon nanotubes and combinations thereof.
4. The electron emitter of claim 1 wherein the carbon nanotube particulate comprises ropes of carbon nanotubes.
5. The electron emitter of claim 4 wherein the ropes have a cross-sectional dimension in a range of about 10 nm and about 50 nm.
6. The electron emitter of claim 4 wherein the ropes have a cross-sectional dimension less than 10 nm.

7. The electron emitter of claim 4 wherein the carbon nanotube particulates comprise small-diameter carbon nanotubes having more than about 10 small-diameter carbon nanotubes/ μm^2 surface area of the carbon nanotube particulates.
8. The electron emitter of claim 4 wherein the carbon nanotube particulate on the surface has been activated by etching.
9. The electron emitter of claim 4 wherein the electron emitter is a component in a cathode of a field emission device.
10. The electron emitter of claim 9 wherein the field emission device is selected from the group consisting of electron tubes, amplifiers, oscillators, mixers, microwave components, discharge initiators, laser tubes, spark gaps, controlled discharge tubes, directed energy devices, display tubes, flat-panel displays and combinations thereof.

EVIDENCE APPENDIX

Definitions from *The American Heritage Dictionary, Second College Edition*, Houghton Mifflin Company, Boston, 1982. These documents were introduced into the record as attachments to the response to office action that was filed on October 11, 2006.

RELATED PROCEEDINGS APPENDIX

None.

